6 Special Topics

6.0 Summary

This chapter provides more complete illustrations of how the *Standards* apply to items that involve all disciplines: envelope, mechanical and lighting. This includes the performance approach, hotel/motel compliance, and high-rise residential compliance.

Section 6.1 summarizes the Performance Approach. It includes a discussion of computer methods and how compliance is shown with a computer method, the procedures involved in determining the energy budget and the proposed building's energy use, and how to plan check performance compliance. Section 6.2 is a discussion of Hotel/Motel buildings and how compliance is demonstrated for those occupancies. Section 6.3 is a discussion of High-rise Residential buildings and how compliance is demonstrated for those occupancies.

6.1 Performance Approach

6.1.1 Summary

This section explains the use of approved public domain and *Alternative Calculation Method* (ACM) computer programs to show compliance with the annual energy budget requirement of the *Standards.* The computer methods represent one of the basic compliance paths explained in Chapter 1.

Performance Concepts (Section 6.1.2) outlines the basis of the computer method approach and the ACM approval process for the use of a computer program with the *Standards.* The following section summarizes the compliance procedure with computer methods.

Section 6.1.2 describes the concepts and procedures involved in using the performance approach. Section 6.1.3 describes analysis procedures used to demonstrate compliance, including the rules used to generate the annual energy budget. Section 6.1.4 outlines and illustrates the plan check documents required when using the performance approach.

***Note*:** This chapter should not be construed as a substitute for the compliance supplement of any particular approved computer program.

6.1.2 Performance Concepts

The Warren-Alquist Act calls for the establishing "performance standards" that predict and compare the source energy use of buildings. Because of their relative accuracy in analyzing the annual energy use of different building efficiency measures, computer programs are the basis of the performance standards.

A computer program (alternative calculation method (ACM)) cannot be used for demonstrating compliance with the *Standards* unless the ACM, the capability tests, and the vendor's certification are reviewed and approved by the *Energy Commission*. The

programs simulate or model the thermal behavior of buildings and the interaction of their space conditioning, lighting and service water heating systems. The calculations include:

- Heat gain and heat loss through walls, roof/ceilings, floors, windows, and skylights.
- Solar gain from windows, skylights, and opaque surfaces.
- Heat storage effects of different types of thermal mass.
- Building operating schedules for people, lighting, equipment and ventilation.
- Space conditioning system operation including equipment part load performance.

The prescriptive requirements were derived from the results of building energy analysis studies using the reference computer program, DOE.

Computer methods are generally the most detailed and flexible compliance path. The energy performance of a proposed building design can be calculated according to actual building geometry and site placement. Credit for certain conservation features, such as a daylit atrium, cannot be taken in the prescriptive approach, but could be evaluated with an approved computer program.

A. Approval of Computer Programs

For any computer program (alternative calculation method) to be used for compliance with the *Standards*, the program must first be approved by the *Energy Commission*. Approval involves the demonstration of minimum modeling capabilities, required input and output, and adequate user documentation. The program must be able to:

- Automatically calculate the custom energy budget.
- Calculate the energy use of the proposed design in accordance with specific fixed and restricted inputs.
- Print the appropriate standardized compliance forms with the required information and format if and only if a proposed building complies. Other reports that do not resemble forms may be printed for noncomplying buildings.

Input and output requirements and modeling capabilities are tested by using the program to calculate the energy use of certain prototype buildings under specific conditions, and the results are compared with the results from a reference computer program following the specified reference methodology. These tests and testing criteria do not allow the approval of an ACM that indicates compliance for a building that the reference method indicates does not comply with the *Standards*.

The *Energy Commission* approves the alternative calculation method according to the procedures outlined in §10-104 and 10-110 of the *California Code of Regulations*, Title 24, Part 1. The procedures are detailed in the *Alternative Calculation Methods Approval Manual for the Energy Efficiency Standards for Nonresidential Buildings, High-rise Residential Buildings and Hotel/Motels (ACM Approval Manual)*. The *Energy Commission* periodically updates a listing of approved computer programs that may be obtained from the Publications Office, by calling the *Energy Commission*'s Hotline at 1-800-772-3300, or by accessing the *Energy Commission*'s Web Site (www.energy.ca.gov/efficiency).

B. The Energy Budget

The energy budget that a building must comply with is composed of three basic components: space conditioning, lighting, and water heating. Space conditioning is further broken into space heating, space cooling, HVAC fans and pumps, and receptacle. It is expressed in source Btu per square foot of conditioned floor area per year (*Standards* §141(b)).

A building complies with the *Standard* if the predicted source *energy use* of the proposed design is the same or less than the annual *energy budget* of the standard design. The energy budget includes a space conditioning budget, lighting budget and water heating budget. The budget for space conditioning varies according to specific characteristics of the proposed building design outlined below.

The energy budget is dependent on how a building is oriented, and the budget will vary with actual building orientation. Other variables that affect the energy budget include:

- Conditioned floor area
- Conditioned volume
- Gross exterior surface area
- Space conditioning system type
- Occupancy type
- Climate zone

Assumptions used by the computer programs in generating the energy budget are explained in detail in the *ACM Approval Manual* , but are based on the prescriptive requirements of the *Standards.* The standard lighting power density for the building is determined by the program based on occupancy type, in accordance with the Complete Building, Area Category, and Tailored rules described in Section 5.2.2.

The Standard Design and Proposed Design for a building is summarized in an Annual Source Energy Use Summary on the PERF-1: Performance Certificate of Compliance form, described in Section 6.1.4 and illustrated in Figure 6-1. The Standard Design is calculated according to the rules and assumptions in the *ACM Approval Manual,* and represents the total allowable energy budget for the building. The Proposed Design must be equal to or less than that of the energy budget for the building to comply.

Figure 6-1– Annual Source Energy Use Summary (Sample of PERF-1, Part 2 of 3)

ANNUAL SOURCE ENERGY USE SUMMARY (kBtu/sf-yr)

ENERGY USE BY COMPONENT	STANDARD DESIGN	PROPOSED DESIGN	COMPLIANCE MARGIN
SPACE HEATING			
SPACE COOLING			
FANS/PUMPS			
LIGHTS			
WATER HEATING			
RECEPTACLE			
TOTAL			

C. Compliance With a Computer Method

Each approved computer program automatically generates an *energy budget* by calculating the annual energy use of the standard design, a version of the proposed building incorporating all the prescriptive features.

Although any single component of the energy use may be higher than the equivalent component in the energy budget, the total combined energy use of the Proposed Design must be less than or equal to the Standard Design. This way, trade-offs can be made between space conditioning, lighting and service water heating energy use. See Section 6.1.2E for restrictions of trade-offs.

Example 6-1– Performance Trade-offs

Question

If a PERF-1 (see Figure 6-1) shows that the proposed energy use of the “HVAC Fans and Pumps” exceeds the standard design energy budget, but the total energy use is less than the energy budget, does the building still comply?

Answer

Yes. More fan energy is being used by the proposed design, but the "Total" proposed energy use is less than the "Total" standard design energy budget, therefore the building complies.

D. Compliance Procedure

Any approved computer program may be used to comply with the *Standards.* The following steps are a general outline of the typical compliance procedure:

1. All detailed data for the building component or components must be collected including glazing, wall, door, roof/ceiling, and floor areas, construction assemblies, shading coefficients, mass characteristics, equipment specifications, lighting, and service water heating information from the drawings and specifications. Section 6.1.3B contains more detailed information on the required computer program inputs.

   Although most computer programs require the same basic data, some information, and the manner in which it is organized, may vary according to the particular program used. *Refer to the compliance supplement that comes with each program for additional details.*

   Be sure that the correct climate zone has been selected for the building site location (see Appendix C).

2. The program user has the option of using default U-factors based on the tables contained in Appendix B, Table B-7. If default U-factors for wall, roof/ceiling, and floor/soffit are not used, prepare the appropriate ENV-3 forms for the various proposed construction assemblies either through the use of the program or by a hand calculation.

3. Prepare an input file that describes the other thermal aspects of the proposed design according to the rules described in the program's compliance supplement.

   Input values and assumptions must correctly correspond to the proposed design and conform to the required mandatory measures described in Chapters 3, 4 and 5.

4. Run the computer program to automatically generate the energy budget of the standard design and calculate the energy use of the proposed design.

The building complies if the total energy use of the proposed design is the same or less than the standard design energy budget.

Note: When creating any computer input file, use the space provided for the project title information to concisely and uniquely describe the building being modeled. User-designated names should be clear and internally consistent with other buildings being analyzed in the same project. Title names and explanatory comments should assist individuals involved in both the compliance and enforcement process.

E. Application Scenarios

Compliance with the performance approach can be done whenever compliance is demonstrated for each permit application. Each application for permit can be either a prescriptive or performance application. Because of this, the following procedures are developed in the *ACM Approval Manual* to limit the use of historical documentation.

Whole Building Compliance

Whole buildings are projects involving buildings where the applicant is applying for permits, and submits plans and specifications for all the features of the building (envelope, mechanical, lighting and service water heating). This could be a first time tenant improvement that involves envelope, mechanical and lighting compliance, or a complete building, where plans and specifications for the entire building are being submitted for permit.

When a whole building is modeled using the performance approach, trade-offs can be made between the envelope, space conditioning, service water heating, and lighting systems that are included in the permit application.

Compliance by Permit Stage

Compliance with only one or more building *permit stages* can be done using the performance approach. A *permit stage* is a portion of a whole building permit: either envelope, mechanical, or electrical. *Standards* §141(b) states that only the features of the building that are included in the building permit application can be modeled. This means that trade-offs in energy use are limited to include only those features included in the building permit application.

There are two basic scenarios that occur when performing compliance by permit stage: modeling *future construction* features that are not included in the permit application, and modeling *existing construction* that has complied with the *Standards.*

Modeling Future Construction by Permit Stage

When a feature of a building is not included in the permit application, it is required to *default* to a feature automatically determined in the computer program. The defaults vary for envelope, mechanical, and lighting. The *ACM Approval Manual* contains additional information on the default values.

The *default envelope features* do not apply when modeling future construction. Usually, this is the first permit requested and at a minimum this feature must be modeled. The proposed building's envelope features are input and an energy budget is automatically generated based on the proposed building's envelope, and/or space conditioning and lighting system.

The *default space conditioning system* features are fixed if no space conditioning system exists in the building. A standard package gas/electric unit is assumed for each thermal zone in the proposed design. The package system is sized based on the envelope design and it meets the prescriptive requirements. If a space conditioning system is included in the permit application, the default space conditioning system is based on the standard design as determined in the *ACM Approval Manual*.

The *default service water heating system* features are fixed based on building occupancy. Default service water heating systems are specified for each occupancy type.

The *default lighting system* features depend on whether or not the occupancy of the building is known. If the building occupancy is known, the Allowed Lighting Power Density is determined using the Complete Building Approach for each zone that the occupancy is known. If the building occupancy is not known, 1.2 watts per square foot is assumed for both the proposed energy use and the energy budget.

Modeling Existing Construction by Permit Stage

When a feature of a building is not included in the permit application, and it is an existing building feature, it is required to *default* to a feature automatically determined in the computer program. The defaults vary for envelope, mechanical, and lighting. The *ACM Approval Manual* contains additional information on the default values.

The *default envelope* features are based on the program user's inputs to the computer program. The proposed building's conditioned floor area, glazing, wall, floor/soffit, roof/ceiling, and display perimeter features are input by the program user. The computer program then applies the proposed building's features to the standard design in order to calculate the energy budget. This means that if an application for an envelope permit is not being sought , the computer program will automatically default the features of the standard design to be the same as the features of the proposed design. Only the EXISTING-ENV will be printed to document the existing building.

The *default space conditioning system* features are fixed based on the building's existing space conditioning system. The program user inputs the existing space conditioning system, including actual sizes and types of equipment. The computer program then applies the proposed building's space conditioning features to the standard design in order to calculate the energy budget. This means that if an application is not being sought for a mechanical permit, the computer program will automatically default the features of the standard design to be the same as the features of the proposed design. No mechanical forms will be printed.

The *default service water heating system* features are fixed based on building occupancy. Default service water heating systems are specified for each occupancy type. Water heating information will only be listed as "existing".

The default lighting system features are based on the known occupancy of the building. The Allowed Lighting Power Density is determined based on the Actual Lighting Power Density of the building. The computer program then applies the proposed building's features to the standard design in order to calculate the energy budget. This means that if an application for a lighting permit is not being sought, the computer program will automatically default the features of the standard design to be the same as the features of the proposed design. No LTG form will be printed. All reported lighting will be reported on the PERF-1 Performance Certificate of Compliance.

Additions Performance Compliance

An addition is treated similar to a new building in the performance approach. Since both new conditioned floor area and volume are created with an addition, all systems serving the addition will require compliance to be demonstrated. This means that either the prescriptive or performance approach can be used for each stage of the construction of the addition.

NOTE: When existing space conditioning or water heating is extended from the existing building to serve the addition, those systems do not need to comply.

Addition Only

Additions that show compliance with the performance approach, independent of the existing building, must meet the requirements for new buildings. *Standards* §149(a)2 states that the envelope and lighting of the addition, and any newly installed space conditioning or service water heating system serving the addition, must meet the mandatory measures and the energy budget determined in the performance run.

If the permit is done in stages, the rules for each permit stage apply to the addition performance run.

If the whole addition is included in the permit application, the rules for whole buildings apply.

Existing plus Addition

Additions may also show compliance by *either* 1) demonstrating that efficiency improvements to the envelope component of the existing building, offset decreased addition performance (see §149(a)2.B.2.), or 2) that the existing building combined with the addition meets the present *Standards* (per §149(b). *Standards* §149(a)2 states that the envelope and lighting of the addition, and any newly installed space conditioning or service water heating system serving the addition, must meet the mandatory measures just as if it was an addition only. It also allows the applicant to improve the energy efficiency of the existing building so that it meets the energy budget that would apply to the entire building, if the existing building was unchanged, and the addition complied on its own. Note that improvements refer to ‘improvements over existing building’ and not to improvements over default envelope features.

It is important to note that the term entire building means the ensemble of all enclosed space in a building, including the space for which a permit is sought, plus all conditioned and unconditioned space within the structure.

To show compliance with this approach you need to follow the instructions in the computer program's compliance supplement.

When using this compliance approach it is important to take into account all changes in the building's features that are removed from or added to the existing building.

Documentation of the existing building's features is required to be submitted with the permit application if this method is used.

Alterations Performance Compliance

Using the performance approach for an alteration is similar to demonstrating compliance with an addition.

Alteration Only

Altered spaces can show compliance with the performance approach independent of the existing building, and must meet the requirements for new buildings. *Standards* §149(b)2 states that the envelope and lighting of the alteration, and any newly installed space conditioning or service water heating system serving the alteration, must meet the mandatory measures and the permitted space alone shall comply with the energy budget determined using an alternative computer program.
If the permit is done in stages, the rules for each permit stage apply to the alteration performance run.

Existing Buildings with Whole Building Approach Alteration

Alterations may also show compliance by demonstrating that efficiency improvements to the existing building offset decreased performance of the permitted space. *Standards* §149(a)2 states that envelope, lighting, space conditioning or service water heating system alterations, must meet the mandatory measures. This approach allows the applicant to improve the energy efficiency of the existing building so that it meets the energy budget that would apply to the entire building if the existing building was unchanged, and the permitted space complied on its own.

To show compliance with this approach you need to follow the instructions in the computer program's compliance supplement.

When using this compliance approach it is important to take into account all changes in the building's features that are removed from or added to the existing building as a part of the alteration.

Documentation of the existing buildings features is required to be submitted with the permit application if this method is used. An EXISTING-ENV report must be presented.

Alternate Performance Compliance Approach

Any addition, alteration or repair may demonstrate compliance by meeting the requirements applicable to new buildings for the entire building. Using this method, the entire building could be shown to comply in permit stages or as a whole building. The rules for new buildings, permit stage compliance, and whole building compliance would apply.

Documentation of the existing buildings features is required to be submitted with the permit application if this method is used.

F. Professional Judgment

As explained in the next section, certain modeling techniques and compliance assumptions applied to the proposed design are fixed or restricted. That is, there is little or no freedom to choose input values regarding specific input variables for compliance modeling purposes. However, there remain other aspects of computer modeling for which professional judgment is necessary. In those instances, it must be exercised properly in evaluating whether a given assumption is appropriate.

Building departments have full discretion to question the appropriateness of a particular input, especially if the user has not substantiated the value with supporting documentation.

Two questions may be asked in order to resolve whether good judgment has been applied in any particular case:

- Is the approach or assumption used in modeling the proposed design consistent with the approach or assumption used in generating the energy budget?

  The rule is to model the proposed design using the same assumption and/or technique used by the program in calculating the energy budget unless drawings and specifications indicate specific differences that warrant conservation credits or penalties.

- Is a simplifying assumption appropriate for a specific case?

- If simplification reduces the energy use of the proposed building when compared to a more explicit and detailed modeling assumption, the simplification is not acceptable.

6.1.3 Analysis Procedures

This section is a summary of the analysis procedures used in demonstrating compliance with approved computer programs. It describes the procedures specified in §141 of the *Standards. Program users and those checking for enforcement should consult the most current version of the user's manuals and associated compliance supplements for specific instructions on the operation of the program*.

Although there are numerous requirements for each ACM input, the data entered into each approved computer program may be organized differently from one program to the next. As a result, it is not possible in this summary to present all variables in their correct order or hierarchy for any one program. The aim is simply to identify the procedures used to calculate the standard design energy budget and the source energy use of the proposed building.

A. Energy Budget

The energy budget consists of three main components: the space conditioning energy budget, the lighting budget, and the service water heating budget. These components are discussed in §141(a)1, 2 and 3 of the *Standards.*

Space Conditioning Energy Budget

The space conditioning budget is defined in *Standards* §141(a)1 as "... the source energy used for space conditioning in a standard building in the Climate Zone in which the proposed building is located, calculated with a method approved by the Commission...." The space conditioning energy budget is automatically determined from the program user's inputs from the corresponding elements of the proposed design. This budget is automatically re-calculated each time a compliance run is done.

The space conditioning energy budget consists of the elements described in the *ACM Approval Manual.*

Lighting Energy Budget

The lighting energy budget is defined in the *Standards* §141(a)2 as "...the source energy used for lighting in a standard building calculated with a method approved by the Commission..." The budget consists of the lighting power used by a building based on one of the following criteria:

- When no lighting plans or specifications are submitted for permit, and the occupancy of the building is not known, the standard lighting power density is 1.2 watts per square foot.

- When no lighting plans or specifications are submitted for permit and the occupancy of the building is known, the *standard lighting power density* is equal to the corresponding watt per square foot value derived in the Complete Building Method (*Standards* §146(b)1).

- When lighting plans and specifications are submitted for permit, the standard and proposed lighting power density is equal to the corresponding total allowed lighting power (in watts) calculated using either the Complete Building Method, the Area Category Method, or the Tailored Method (*Standards* §146(b)1, 2 or 3). A complete set of lighting plans and prescriptive forms are required for use of the Tailored Lighting Method in the performance approach. The ACM calculated lighting power must always be within 2% of the lighting power calculated by the performance approach.

The *Standards* only allow lighting trade-offs against the allowed watts per square foot based on actual occupancy (general lighting categories A through D). Submitted lighting plans must show lighting loads equal to or less than on the energy documentation.

Service Water Heating Energy Budget

The service water heating energy budget is defined in the *Standards* §141(a)3 as "...the source energy used for service water heating in a standard building calculated in the Climate Zone in which the proposed building is located, calculated with a method approved by the Commission...." The budget consists of the service water heating energy used by a building assuming the service water heating system meets both the mandatory and prescriptive requirements as described in Section 4.2.1J and 4.2.2J of this *Manual* (*Standards* §111, §113 and §123).

B. Source Energy Use

The source energy use consists of three main components; the space conditioning energy use, the lighting energy use, and the service water heating energy use. These components are discussed in §141(b)1, 2, and 3 of the *Standards.*

The key component of calculating the source energy use of the proposed building is that if a feature of the building is not included in the building permit application, the energy use of that feature is equal to that of the standard energy budget (*Standards* §141(b)). That means that if a permit is submitted for a shell building (envelope only), and the performance approach is used to demonstrate compliance, trade-offs cannot be made between the envelope and the mechanical or lighting system.

Space Conditioning Source Energy Use

The space conditioning source energy use must be calculated using a method approved by the *Energy Commission*. The following elements are used by the approved computer programs. These elements must be consistent with plans and specifications submitted in the building permit application:

Gross Exterior Surfaces: All gross exterior surfaces, each with its respective area, orientation and tilt.

Opaque Exterior Walls: Each opaque exterior wall construction assembly, as well as wall area, orientation and tilt. Heat capacities, or characteristics necessary to determine the heat capacity (conductivity, mass, volume) of opaque exterior walls, must be included.

Doors: All doors must be included.

Opaque Roofs/Ceilings: Each opaque exterior roof/ceiling construction assembly, as well as roof/ceiling area, orientation and tilt. Heat capacity, or characteristics necessary to determine the heat capacity (conductivity, mass, volume) of opaque exterior roof/ceilings, must be included.

Raised Floors and Slab Floors: Each floor construction assembly, as well as floor area.

Glass in Walls and Shading: Each vertical glass area, orientation, tilt, U-factor and shading coefficient.

Horizontal (Skylight) Glass and Shading: Each horizontal or skylight glass area, orientation, tilt, U-factor and shading coefficient.

Ventilation (Outside) Air: Ventilation (or outside air) values in cfm/ft² .

Fan Power: Fan power must be included.

Cooling and Heating Efficiency: The actual efficiency of the equipment included in the proposed design.

No Heating or Cooling Installed: If total heating or cooling capacity is not specified, the source energy use will be based on a standard design heating or cooling system (*Standards* §141(b)).

Cooling System Capacity: Sensible output capacity of the cooling system at ARI conditions.

Heating System Capacity: The output capacity of the heating system.

Other System Values: All other space conditioning system components that are used by approved computer programs.

Refer to the *ACM Approval Manual* for more detailed information on how each of the above values are used by the computer programs.

Lighting Source Energy Use

The lighting source energy use is calculated using a method approved by the *Energy Commission*. When plans and specifications are submitted for permit, the lighting source energy use is calculated using the following elements:

Proposed Lighting Power Density: For all occupancies except Hotel Guest Rooms and High-rise residential living quarters, the proposed lighting power density, in watts per square foot (*Standards* §141(a)2).

For residential occupancies (Hotel Guest Rooms or High-rise Residential Buildings), the approved computer program will always fix the proposed lighting power density at the values listed in the *ACM Approval Manual.*

Service Water Heating Source Energy Use

The service water heating source energy use is calculated using a method approved by the *Energy Commission*. It is calculated using a method described in the *ACM Approval Manual* using the proposed building service water heating system. This system must be consistent with plans and specifications submitted in the building permit application

6.1.4 Performance Plan Check Documents

At the time a building permit application is submitted to the building department, the applicant also submits plans and energy compliance documentation. This section describes the forms and procedures for documenting compliance with the performance requirements of the *Standards* when an Alternative Calculation Method (ACM), typically a computer program, is used to demonstrate compliance. The *ACM Approval Manual* has specific and detailed output/reporting requirements for all approved ACMs. The administrative regulations require certain specific forms and only those forms for a particular type of compliance by referencing the *ACM Approval Manual* requirements.

ACM compliance output is required to specify the run initiation time, a unique runcode, and the total number of pages of forms printed for each proposed building run whenever a building complies with the *Standards* and compliance output has been selected. The plan checker is strongly encouraged to verify these output features for a performance compliance submittal to ensure that the submittal is a consistent set of compliance documentation. The *ACM Approval Manual* forbids an ACM from printing standard compliance forms for a proposed building design that does not comply. The plan checker should pay special attention to the PERF-1 form and the Exceptional Conditions List on Part 2 of that form. Every item on the Exceptional Conditions List deserves special attention and requires additional documentation such as manufacturer's cut sheets or special features on the plans and in the building specifications.

The ACM requirements will automatically produce and reiterate the proper set of forms that correspond to the particular proposed building submitted for a permit, but the plan checker should verify the type of compliance and the required forms from the lists below. Whenever an existing building (or building components) is involved in compliance, the plan checker should look for an EXISTING form that documents EXISTING building components. Similarly if the compliance indicates existing components - partial permit compliance, addition, addition plus existing building, or any alteration, an EXISTING form must be submitted. In the types of permit applications where some building components are unknown the unknown components cannot be entered by the user and cannot be reported on output forms.

This section does not describe the details of the performance approach; these are reviewed in Section 6.1.1 and 6.1.2, in the computer program vendors' compliance supplements, and in the *ACM Approval Manual*. The following discussion is addressed primarily to the building department plan checkers who are examining documents

submitted to demonstrate compliance with the *Standards*, and to the designer preparing construction documents and compliance documentation.

Most compliance forms associated with the computer method approach are generated automatically. These reports are similar in information content and layout to their prescriptive method counterparts. The main difference is appearance because computer method forms are designed to be reproducible using a dot matrix printer.

The following summary identifies the forms that are required for performance compliance. All submittals must contain the following information:

- Unless minimal efficiency and default capacities are used in the performance analysis, either equipment cut sheets showing rated capacities, fan bhp, and air flow at ARI conditions, or the installation certificate must be provided.
- Other documentation supporting each non-standard or non-default value used in the performance approach and indicated in the Exceptional Conditions list on the PERF-1 form must also be included.

Other reports that may be generated by a program are:

- ENV-3: Construction Assemblies
- Formatted Copy of Input

The following computer generated forms are required by the *ACM Approval Manual* for a permit application:

Whole Building Compliance (the number of parts is the minimum number of pages)

- PERF-1: Performance Certificate of Compliance (3 parts)
- ENV-1: Envelope Compliance Summary (1 part)
- MECH-1: Mechanical Compliance Summary (2 parts)
- MECH-2: Mechanical Equipment Summary (2 parts)
- MECH-3: Mechanical Compliance Summary/Mechanical Ventilation (1 part)
- LTG-1: Lighting Compliance Summary (1 part)

The LTG-3 (Lighting Controls Credit Worksheet) and LTG-4 (Tailored LPD Summary and Worksheet) forms may be, and typically will be, submitted by hand. When these pages are hand submitted or submitted independently, they will not be included in the page count automatically generated by the computer for a compliance submittal.

Note: The use of the tailored lighting approach requires independent prescriptive compliance for the lighting system.

Compliance By Permit Stage (the number of form parts are the same as indicated above at Whole Building Compliance)

A. Envelope Only

- PERF-1: Performance Certificate of Compliance
- ENV-1: Envelope Compliance Summary
- ENV-3: Construction Assemblies
- Possibly existing LTG and existing MECH forms: (for partial compliance alteration)

B. Envelope and Mechanical

- PERF-1: Performance Certificate of Compliance
- ENV-1: Envelope Compliance Summary
- MECH-1: Mechanical Compliance Summary

- MECH-2: Mechanical Equipment Summary
- MECH-3: Mechanical Compliance Summary/Mechanical Ventilation
- Possibly existing LTG forms: (for partial compliance alteration)

C. Mechanical Only

- PERF-1: Performance Certificate of Compliance
- MECH-1: Mechanical Compliance Summary
- MECH-2: Mechanical Equipment Summary
- MECH-3: Mechanical Compliance Summary/Mechanical Ventilation
- Possibly existing ENV and/or existing LTG forms: (for partial compliance alteration)

D. Mechanical and Lighting

- PERF-1: Performance Certificate of Compliance
- MECH-1: Mechanical Compliance Summary
- MECH-2: Mechanical Equipment Summary
- MECH-3: Mechanical Compliance Summary/Mechanical Ventilation
- LTG-1: Lighting Compliance Summary
- LTG-3: Lighting Controls Credit Worksheet (if control credits used)
- LTG-4: Tailored LPD Summary and Worksheet (if tailored lighting used)
- Possibly existing ENV forms: (for partial compliance alteration)

E. Lighting Only

- PERF-1: Performance Certificate of Compliance
- LTG-1: Lighting Compliance Summary
- LTG-3: Lighting Controls Credit Worksheet (if control credits used)
- LTG-4: Tailored LPD Summary and Worksheet (if tailored lighting used)
- Possibly existing ENV and existing MECH forms: (for partial compliance alteration)

Consult the computer program's compliance supplement for a detailed summary of what additional documentation may need to be included in the permit application along with the automatically-generated compliance documentation.

F. PERF-1: Performance Certificate of Compliance

The PERF-1 incorporates the first parts of the prescriptive ENV-1, LTG-1, and MECH-1 on the first part or first page. This is a combined signature document for the certificate of compliance that documents the party(ies) who has primary responsibility for the design of the envelope, lighting and mechanical systems of the building. The total Btu/ft² /yr for the standard design energy budget must be equal to or greater than the proposed design's energy use.

The signature statement is to certify that the documentation author correctly represented the building in the performance program.

The PERF-1 form must appear on the plans (usually near the front of the architectural drawings). A copy of this form should also be submitted to the building department along with the rest of the compliance submittal at the time of building permit application. This form must be generated by an approved alternative computer program.

G. ENV-1: Envelope Compliance Summary

The performance ENV-1 Certificate of Compliance form has one part. It summarizes the opaque surfaces including surface type, construction type, area, azimuth, and U-factor . Next it summarizes the fenestration surfaces including fenestration type, area, azimuth, U-factor, frame type and solar heat gain coefficient. Lastly, it includes exterior shading

and overhangs including shade type, solar heat gain coefficient, overhang height and overhang width.

For a description of the information contained on the ENV-1 Certificate of Compliance, see ENV-1, Part 2 of 2, Section 3.3.1.

H. ENV-3: Construction Assemblies

This form is identical to the form required in the prescriptive approach and is described in Section 3.3.4, 3.3.5, and 3.3.6.

I. EXISTING-ENV: Performance Method Only

The ENV-E Performance Method form is used to identify a space. The intention of this form is to be used only in cases where the envelope has complied previously and compliance is now being sought for lighting, mechanical or both. The form includes address, date envelope complied, space name, occupancy, floor area, and volume. The form also identifies opaque surface areas and U-factors as well as glazing surface areas, U-factors, and shading coefficients.

J. MECH-1: Certificate of Compliance

The MECH-1 Certificate of Compliance form is in two parts. This form identifies the system features, duct insulation and pipe insulation that will be verified by the field inspector.

For a description of the information contained on the MECH-1 Certificate of Compliance, see Section 4.3.1 and consult the computer program's compliance supplement.

K. MECH-2: Mechanical Equipment Summary

The MECH-2 Mechanical Equipment Summary identifies the mechanical equipment modeled in the alternative computer program to show compliance. The form contains the information of the equipment name, type, number of pieces, efficiency and size, and is broken down by plant equipment (chillers, boilers, VAV, etc.) and exhaust fans.

For more information on the MECH-2, see Section 4.3.2 refer to computer program’s compliance supplement.

L. MECH-3: Mechanical Ventilation

The MECH-3 Mechanical Ventilation contains the information on the design outdoor ventilation rate for each space. Refer to the discussion in Section 4.3.3, and the computer program’s compliance supplement for more information.

M. LTG-1: Certificate of Compliance

The LTG-1 Certificate of Compliance is a multiple part form. It is used to describe the lighting fixtures and control devices designed to be installed in the building.

For a description of the information contained on the LTG- Certificate of Compliance , see LTG-1, Part 1-3 in Section 5.3.1.

If control credits were input by the program user, a copy of the LTG-3 must accompany the permit application. If the Tailored LPD was used, a copy of the LTG-4 must accompany the permit application along with a complete set of lighting plans and specifications.

6.1.5 Performance Inspection

Performance approach inspection is identical to other inspections required by the *Standards.* For information on inspection envelope, mechanical and lighting systems, see the field inspection checklist and inspection instructions, which can be found in Appendix I of this manual.

When tailored lighting is used to justify increases in the lighting load, a lower lighting load cannot be modeled for credit. The standard design building uses the lesser of allowed watts per square foot or actual lighting power to be installed in the building. The proposed design building uses the actual lighting power to be installed as detailed on the lighting plans. This value must be equal to or greater than the allowed watts per square foot.

6.2 Hotels and Motels

6.2.1 Introduction

This section discusses the requirements of the *Standards* as they apply to hotels and motels. It addresses both the similarities and differences between showing compliance for a hotel/ motel and any other nonresidential or high-rise residential building. Additional information is presented regarding documenting special situations in hotel/motel compliance, and plan checking.

The design of a hotel or motel is unique in that the design must incorporate a wide variety of occupancies and functions into one structure. The occupancies range from nonresidential occupancies to hotel/motel guest rooms. Design functions that affect guests range from the "experience of arrival" created through the main lobby's architectural features to the thermal comfort of the guest rooms. Other functions that hotel/motel designs must address include restaurants, kitchens, laundry, storage, light assembly, and other items that are necessary to the hotel/motel function. In short, these structures can range from simple guest rooms with a small office, to a structure encompassing a small city.

The following sections discuss how they comply with the *Standards*.

6.2.2 Hotel/Motel Compliance Approaches

The *Standards* treat hotels/motels similarly to other occupancies: compliance is submitted for the features covered in the permit application only. Occupancy type is considered in two cases: Nonresidential portions of hotel/motels and guest room portions of hotels/motels. The nonresidential areas of hotels/motels must meet the envelope, mechanical, and lighting portions of the *Energy Efficiency Standard for Nonresidential Buildings*, and the guest room portions of hotels/motels must meet the envelope, mechanical and lighting provisions applicable only to hotels/motel guest rooms. In essence, each occupancy individually complies with the provisions applicable to that occupancy.

6.2.3 Basic Hotel/Motel Concepts

Since hotel/motels are treated as a mixture of occupancies covered by the *Standards*, the concepts presented at the beginning of each chapter apply equally to hotels/motels as they would any other nonresidential occupancy. Special cases where hotels/motel concepts are discussed include the following:

- Section 2.2.1A discusses occupancies that are covered by the *Standards.* This includes the definition of hotels/motels and a discussion of how to determine whether a building is a hotel/motel, high-rise residential, or low-rise residential.

- Section 5.1.1B includes a list of occupancy types that may be used to determine the lighting power density. The full definitions of these occupancies are included in Appendix G.

6.2.4 Hotel/Motel Compliance

The following subsections discuss the special compliance requirements that apply to hotel/motel occupancies.

A. Mandatory Measures

The mandatory measures for envelope, mechanical and lighting, as described in Sections 3.2.1, 4.2.1 and 5.2.1, apply to hotels/motels.

In addition, a special requirement applies to the lighting in hotel/motel guest rooms. This requirement states that 90 percent of the hotel/motel guest rooms must meet bathroom and kitchen lighting requirements, if any that apply to low-rise residential buildings. An explanation of this requirement is included in Appendix H.

Exceptions: The following exceptions to mandatory measures are specific to hotel/motels:

Envelope

- Manufactured fenestration products installed in hotel/motel guest rooms must be certified as meeting the nonresidential values for both air infiltration and fenestration U-factor. If default U-factors are used, they shall be consistent with the default values contained in Section 3.1.2I. If an NFRC certified fenestration product is used, the U-factor for commercial size categories shall be used.

Mechanical

- Hotel and motel guest room thermostats shall have numeric temperature settings. Section 4.2.1I contains an explanation of these requirements.

- Process loads in hotels and motels are discussed in Section 4.2.1I . Process loads in hotels/motels are treated similar to any other nonresidential building.

Lighting

- Readily accessible area switching controls are not required in public areas provided switches that control the lights in public areas are accessible to authorized personnel.

- Automatic shut-off controls are not required for hotel/motel guest rooms.

Following are examples of the noteblocks that should be rewritten to actual conditions. A noteblock for each of the items listed should be included, even if the noteblock states “not applicable”.

Note: Guestrooms in hotel/motel buildings must comply with the following mandatory measures, per Title 24 §122(c) and 130(b). When this noteblock is incorporated into the permit documents or building plans, the applicable features noted shall be considered by all parties as binding minimum component performance specifications for the mandatory measures whether they are shown elsewhere in the documents. This noteblock does not include nonresidential mandatory envelope, lighting, and mechanical mandatory measures, which are also applicable to Hotel/Motel buildings. See 3.2.1, 4.2.1, 5.2.1, and 6.2.4 for more examples of noteblocks for nonresidential mandatory measures.

Example 6-2 - Sample Notes: For Hotel and Motel Mandatory Measures

HOTEL/MOTEL GUEST ROOM SPACE CONDITIONING SYSTEM MEASURE
Thermostat Setpoints

- ❑ Equipped with numeric temperature setpoints in ^{0}F and setpoint stops accessible only to authorized personnel, to restrict over-heating and over cooling. §122(c)

HOTEL/MOTEL GUEST ROOM LIGHTING MEASURE
Lighting

- ❑ 40 lumens/watt or greater for general lighting in kitchens and rooms with water closets; and recessed ceiling fixtures that are IC (insulating cover) approved. §130(b)

B. Prescriptive Compliance

The prescriptive requirements for envelope, mechanical and lighting, as described in Sections 3.2.2, 4.2.2, 5.2.2 and 6.2 apply to hotel/motels.

The following prescriptive requirements are specific to hotel/motels:

Envelope

- Special requirements apply to the envelope in hotel/motel guest rooms. These requirements state that the envelope must meet the prescriptive envelope criteria for high-rise residential buildings rather than the prescriptive criteria for nonresidential buildings. An explanation of this requirement is included in Sections 3.2.2.

Mechanical

- Hotel and motel guest rooms are not required to have economizer controls. Section 4.2.2F contains an explanation of these requirements.

Lighting

- Guest rooms in hotel/motels are exempt from the lighting power density requirements. Section 5.2.4A contains a discussion of exempt lighting.

- Each occupancy (other than guest rooms) in the hotel/motel must comply with either the Area Category Method or the Tailored Method. The Complete Building Method may not be used. These methods cannot be mixed within a permit application. See Section 5.2.2 for a more complete discussion of how to use these compliance approaches.

C. Performance Compliance

The rules for performance compliance are identical to the rules for complying all other nonresidential and high-rise residential buildings. The area of each function of a hotel/motel is input into the program along with its corresponding envelope, mechanical and lighting features. The computer program will automatically calculate an energy budget for the standard design, and the proposed design's energy use.

A complete discussion of the performance approach is included in Section 6.1.

6.2.5 Hotel/Motel Plan Check Documents

Documenting compliance with the S*tandards* is similar to complying other nonresidential or high-rise residential buildings. The forms, and instructions for completing the forms, are included in Sections 3.3, 4.3, 5.3 and 6.1.4 of this manual. Exempt lighting, including guest room lighting, does not have to be listed on the LTG-1, or LTG-4 tailored forms, but should be clearly identified on the plans.

6.2.6 Hotel/Motel Inspection

Inspecting for compliance with the *Standards* is similar to complying other nonresidential or high-rise residential buildings. The field inspection checklist and inspection instructions can be found in Appendix I of this manual.

6.3 High-rise Residential

6.3.1 Introduction

This section discusses the requirements of the *Standards* as they apply to high-rise residential buildings. It addresses both the similarities and differences between showing compliance for a high-rise residential building and any other nonresidential building. Additional information is presented regarding documenting special situations in high-rise residential compliance, plan checking, and field inspection.

The design of a high-rise residential building must incorporate the envelope and mechanical elements of a nonresidential building, with the lighting and service hot water needs of residential buildings. The *Standards* address these features of high-rise residential buildings as described below.

6.3.2 High-rise Residential Compliance Approaches

The *Standards* treat high-rise residential buildings similar to any other occupancy: compliance is submitted for the features covered in the permit application only. Occupancy type is considered in two cases: Portions of high-rise residential buildings that are considered living quarters, and all other portions of the building. Living quarters are

those non-public portions of the building in which a resident lives. The nonresidential areas of high-rise residential buildings are all other areas.

The nonresidential areas must meet the lighting portions of the *Energy Efficiency Standard for Nonresidential Buildings*, and the living quarters must meet the lighting and service water heating provisions applicable only to high-rise residential living quarters.

6.3.3 Basic High-rise Residential Concepts

The concepts presented at the beginning of each chapter apply equally to high-rise residences as they would any other nonresidential occupancy. Special cases where high-rise residence concepts are discussed include the following:

- Section 2.2.1A discusses occupancies that are covered by the *Standards*. This includes the definition of high-rise residential and a discussion of how to determine whether a building is a high-rise residence, or low-rise residence.

- Section 5.1.1B includes a list of occupancy types that may be used to determine the lighting power density. The full definitions of these occupancies are included in Appendix G.

6.3.4 High-rise Residential Compliance

The following subsections discuss the special compliance requirements that apply to high-rise residential occupancies.

A. Mandatory Measures

The mandatory measures for envelope, mechanical and lighting, as described in Sections 3.2.1, 4.2.1 and 5.2.1, apply to high-rise residential buildings including Section 6.3.4A above

In addition, a special requirement applies to the lighting in high-rise residential living quarters. This requirement states that the living quarters must meet bathroom and kitchen lighting requirements that apply to low-rise residential buildings. An explanation of this requirement is included in Appendix H.

The following exceptions to mandatory measures are specific to high-rise residential buildings:

Envelope

- Manufactured fenestration products installed in high-rise residential buildings must be certified as meeting the nonresidential values for both air infiltration and fenestration U-factor. If default U-factors are used, they shall be consistent with the default values contained in Section 3.1.2I. If an NFRC certified fenestration product is used, the U-factor for commercial size categories shall be used.

Mechanical

- High-rise residential occupancies must meet setback requirements applicable to low-rise residential occupancies.

Lighting

- Readily accessible area switching controls are not required in public areas provided switches that control the lights in public areas are accessible to authorized personnel.

- Automatic shut-off controls are not required for living quarters.

Following are examples of the noteblocks that should be rewritten to actual conditions. A block note for each of the items listed should be included, even if the noteblock states “not applicable”

Note: Dwelling Units in high-rise residential buildings must comply with the following mandatory measures, per Title 24 §122(c), 130 (b) and 150(i). When this noteblock is incorporated into the permit documents or building plans, the applicable features noted shall be considered by all parties as binding minimum component performance specifications for the mandatory measures whether they are shown elsewhere in the

documents or on the checklist only. This noteblock does not include nonresidential mandatory envelope, lighting, and mechanical mandatory measures, which are also applicable to High-Rise Residential buildings. See 3.2.1, 4.2.1, 5.2.1, and 6.3.4 above for more examples of noteblocks for nonresidential mandatory measures.

Example 6-3 – Sample Notes: High-Rise Residential Mandatory Measures

HIGH-RISE RESIDENTIAL DWELLING UNIT SPACE CONDITIONING MEASURE
Setback Thermostats

- ❑ All heating and /or cooling systems other than wood stoves shall have an automatic thermostat with a clock mechanism for at least two periods within 24 hours. §122(c) and §150(i).

HIGH-RISE RESIDENTIAL DWELLING UNIT LIGHTING MEASURE
Lighting

- ❑ *40 lumens/watt or greater for general lighting in kitchens and rooms with water closets; and recessed ceiling fixtures that are IC (insulating cover) approved. §130(b)*

B. Prescriptive Compliance

The prescriptive requirements for envelope, mechanical and lighting, as described in Sections 3.2.2, 4.2.2F and 5.2.2, apply to high-rise residences.

The following prescriptive requirements are specific to high-rise residences:

Envelope

- Special requirements apply to the envelope in high-rise residential buildings. These requirements state that the envelope must meet the prescriptive envelope criteria for high-rise residential buildings rather than the prescriptive criteria for nonresidential buildings. An explanation of this requirement is included in Section 3.2.2.

Mechanical

- High-rise residential living quarters are not required to have economizer controls. Section 4.2.2F contains an explanation of these requirements.

Lighting

- High-rise residential living quarters are exempt from the lighting power density requirements. Section 5.2.4A contains a discussion on exempt lighting.
- Each occupancy (other than living quarters) in the high-rise residence must comply with either the Area Category Method or the Tailored Method. These methods cannot be mixed within a permit application. See Section 5.2.2 for a more complete discussion of how to use these compliance approaches.

C. Performance Compliance

The rules for high-rise residential performance compliance are identical to the performance compliance rules for all nonresidential buildings. The area of each function of a high-rise residence is input into the program along with its corresponding envelope, mechanical and lighting features. The computer program will automatically calculate an energy budget for the standard design, and the proposed design's energy use.

A complete discussion of the performance approach is included in Section 6.1.

6.3.5 High-rise Residential Plan Check Documents

Documenting high-rise residential compliance with the *Standards* is similar to documenting compliance for other nonresidential buildings. The forms, and instructions for completing the forms, are included in Sections 3.3, 4.3, 5.3, 6.1 and Appendix H of this manual.

6.3.6 High-rise Residential Inspection

Inspecting high-rise residential for compliance with the *Standards* is similar to inspecting for compliance with other nonresidential buildings. The field inspection checklist and inspection instructions can be found in Appendix I of this manual.